MERCURY SEAL

R & W.
ROGERS AND WELLS ENGRAVERS AND PRINTERS CHICAGO

Jas. A. Trane
Vacuum Heating Company

1902

Offices & Salesrooms

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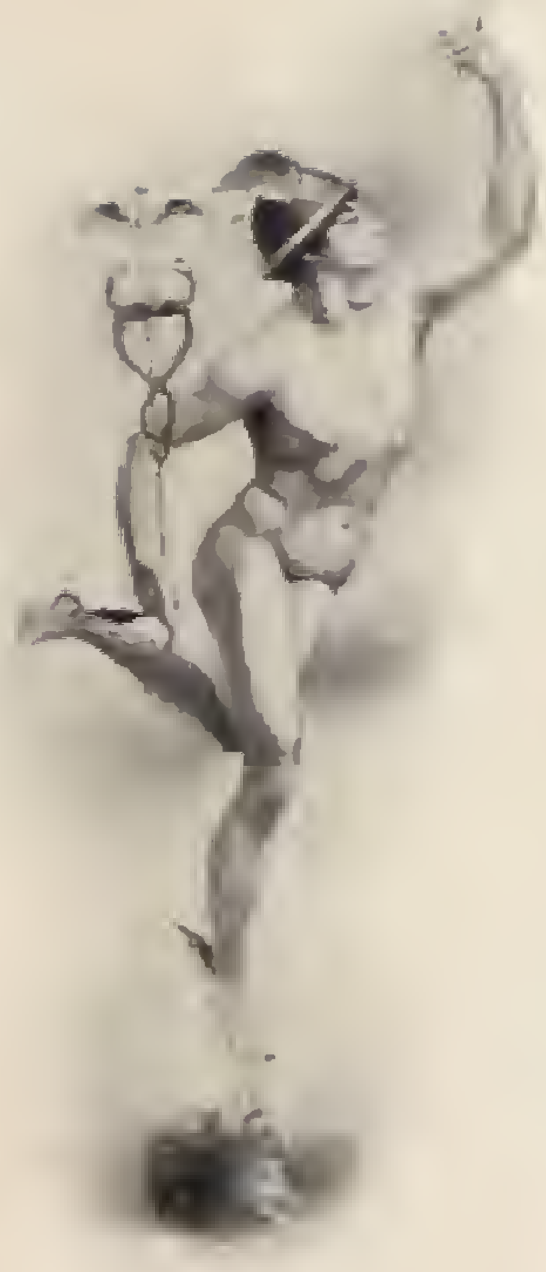
Explanatory



IN INTRODUCING to the Heating Engineer, Architect, and Owner, the Jas. A. Trane Gravity Vacuum System of Steam Heating, we do so only after making careful tests of our system and arriving at the conclusion that vacuum heating procures for the user more than we have for years dared to claim for it. Vacuum heating is not new, but, on the contrary, has been employed for many years. Nearly all of the large buildings in this country are warmed by the vacuum system of heating.

In presenting the Jas. A. Trane Gravity Vacuum System, we bring before the public the first vacuum system that is perfectly automatic, and which relieves the user from the expense heretofore necessary of employing a competent man to manage the apparatus.

At the present time there are many Trane Vacuum Plants in actual operation, and it is only after carefully ascertaining its capabilities and advantages over all other modern methods of heating, that we introduce to you our Mercury Seal—the long sought for solution of this important problem.

JAS. A. TRANE
VACUUM HEATING COMPANY

PLATE 1

Plate 1 illustrates the Jas. A. Trane Mercury Seal as used with the indirect system, in which all the radiators are connected by air pipes to the one Mercury Seal which is located near the boiler. This seal is constructed on the principle of the ordinary barometer, and holds a quantity of mercury sufficient to entirely cover the end of the air tube which dips down into it, even when absolute vacuum has caused the maximum possible amount of mercury to rise into the tube. However, the shape of the mercury cup is such that a steam pressure of one-half pound will readily expel the air, thus necessitating a temperature not exceeding 214.5 degrees.

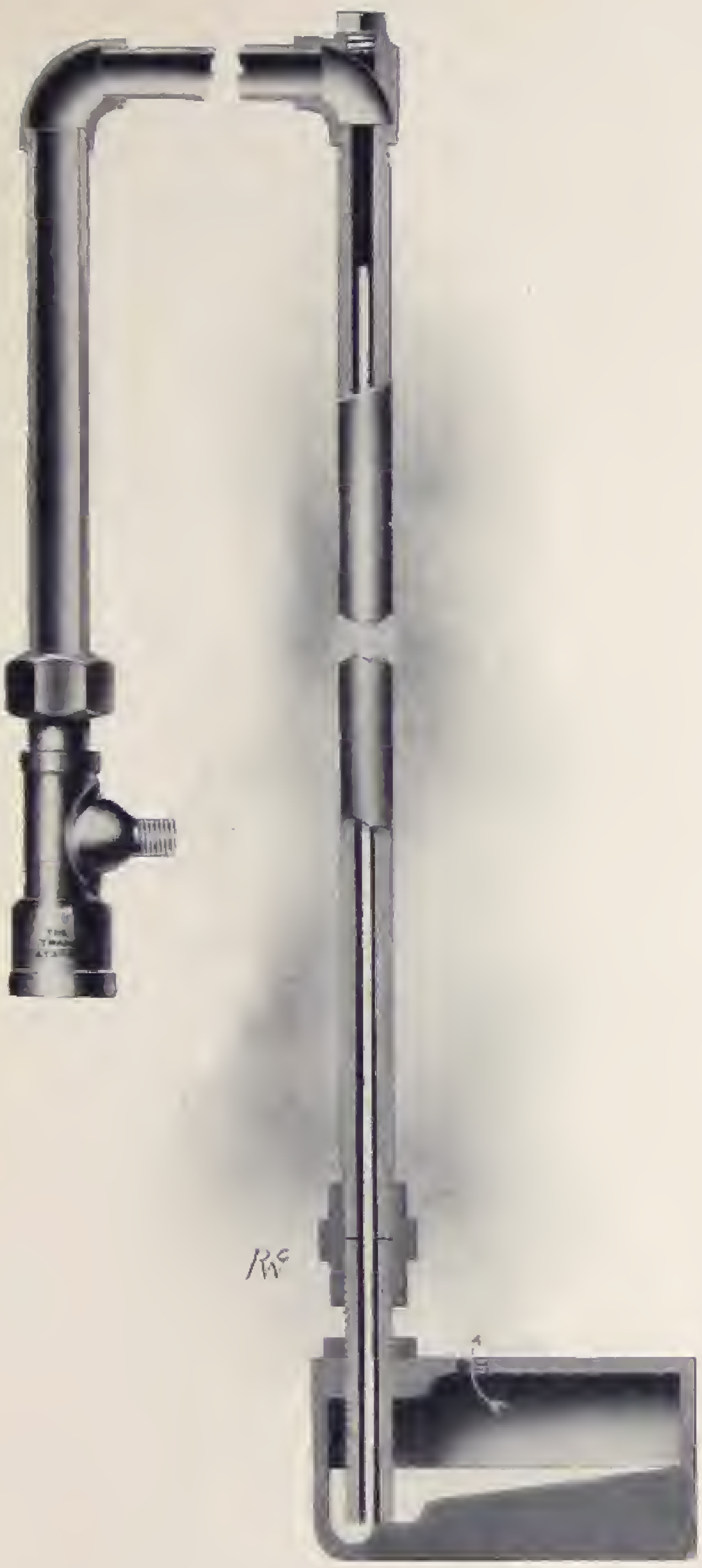


PLATE II

Plate II represents the Jas. A. Trane Direct Mercury Seal. By the use of this apparatus, a low pressure steam plant may with little expense and without annoyance be converted into a gravity vacuum heating system. By the use of an automatic device, often termed air valve or retarder, the air is allowed to escape through the valve, passing upward, then between the loops of the radiator down to a point near the floor, where the mercury seal is attached. By the use of this appliance the system of air piping is not required, and but little expense is involved in the attachment.

Plate III illustrates this seal as attached to the radiator. You will notice the seal is between the radiator loops, also between the radiator and the partition, which makes the seal invisible.

This seal is designed not only for use on steam plants which are already in operation, but can be used on any job where a system of air piping is not desirable.

PLATE III

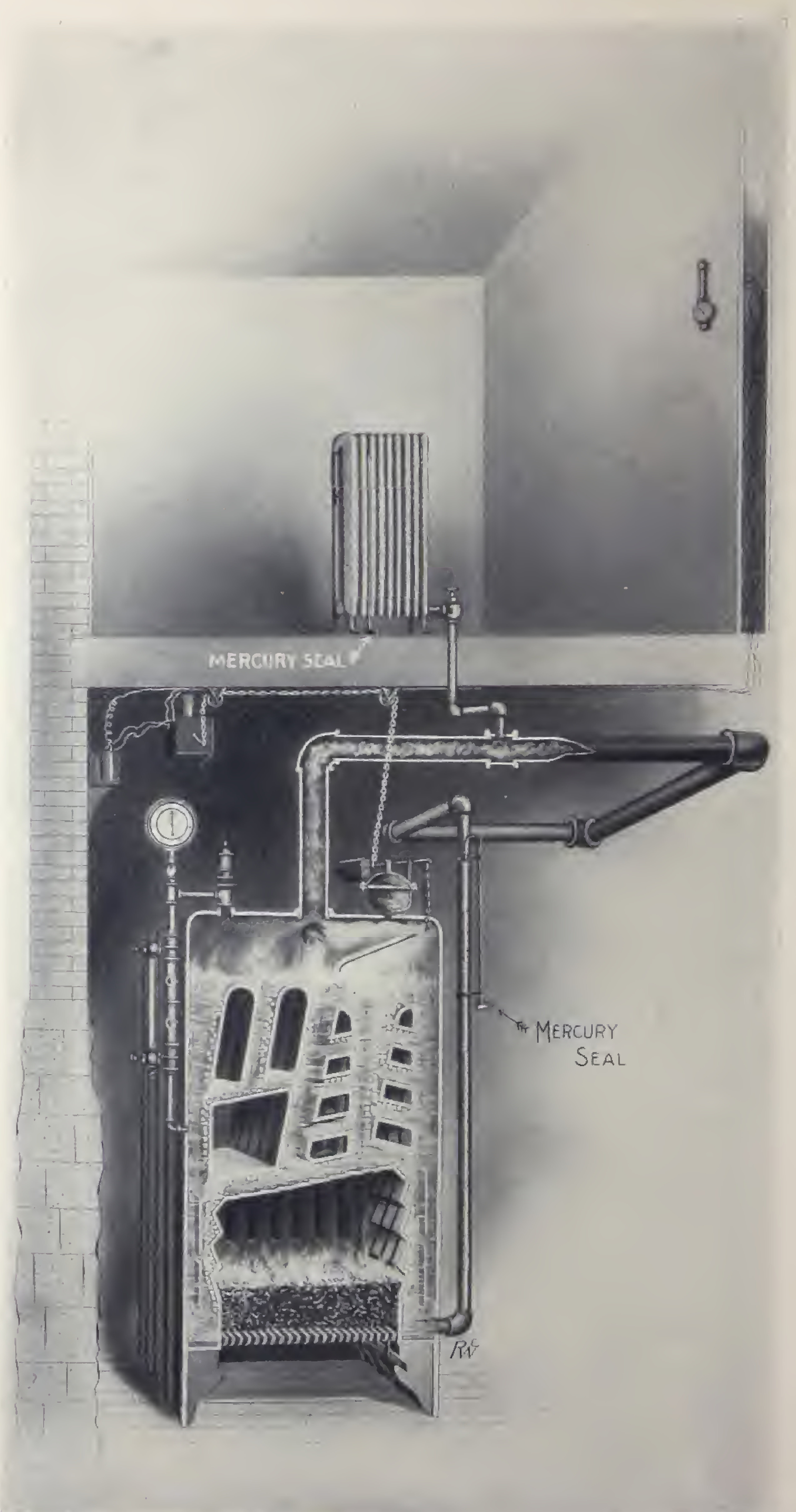


PLATE IV

Plate IV represents an open view of a low pressure steam apparatus, to the radiator of which is attached a Jas. A. Trane Direct Mercury Seal, thus converting it into a gravity vacuum heating plant, but without the use of the air pipes. A diaphragm regulator is attached to the boiler, permitting it to provide any desired pressure, thus allowing for sufficient pressure to expel the air from the system. This diaphragm works independently of the thermostat, up to such time as the air in the room is raised to the desired temperature, at which time the thermostat, which is connected to the battery and motor, closes the drafts. The thermostat then remains in control until such time as the air in the room cools below the required temperature, when the drafts are released and the diaphragm is again given control.

By the joint action of the thermostat and diaphragm the apparatus is made thoroughly automatic, permitting steam pressure to expel the air, and allowing condensation to create a vacuum.

With a Hot Water Apparatus, a quantity of water is required sufficient to entirely fill the boiler, piping and radiation, while with a vacuum system, as shown in Plate IV, only sufficient water is necessary to partly fill the boiler alone. The number of heat units required to raise the temperature of the water in each case to the same degree should illustrate beyond a doubt the economy of the vacuum system.

Take for example a residence requiring one thousand square feet of hot water radiation; such a plant would require from six to seven hundred gallons of water. The same building can be heated by our vacuum system requiring only about six hundred and fifty feet of radiation and less than one hundred gallons of water.

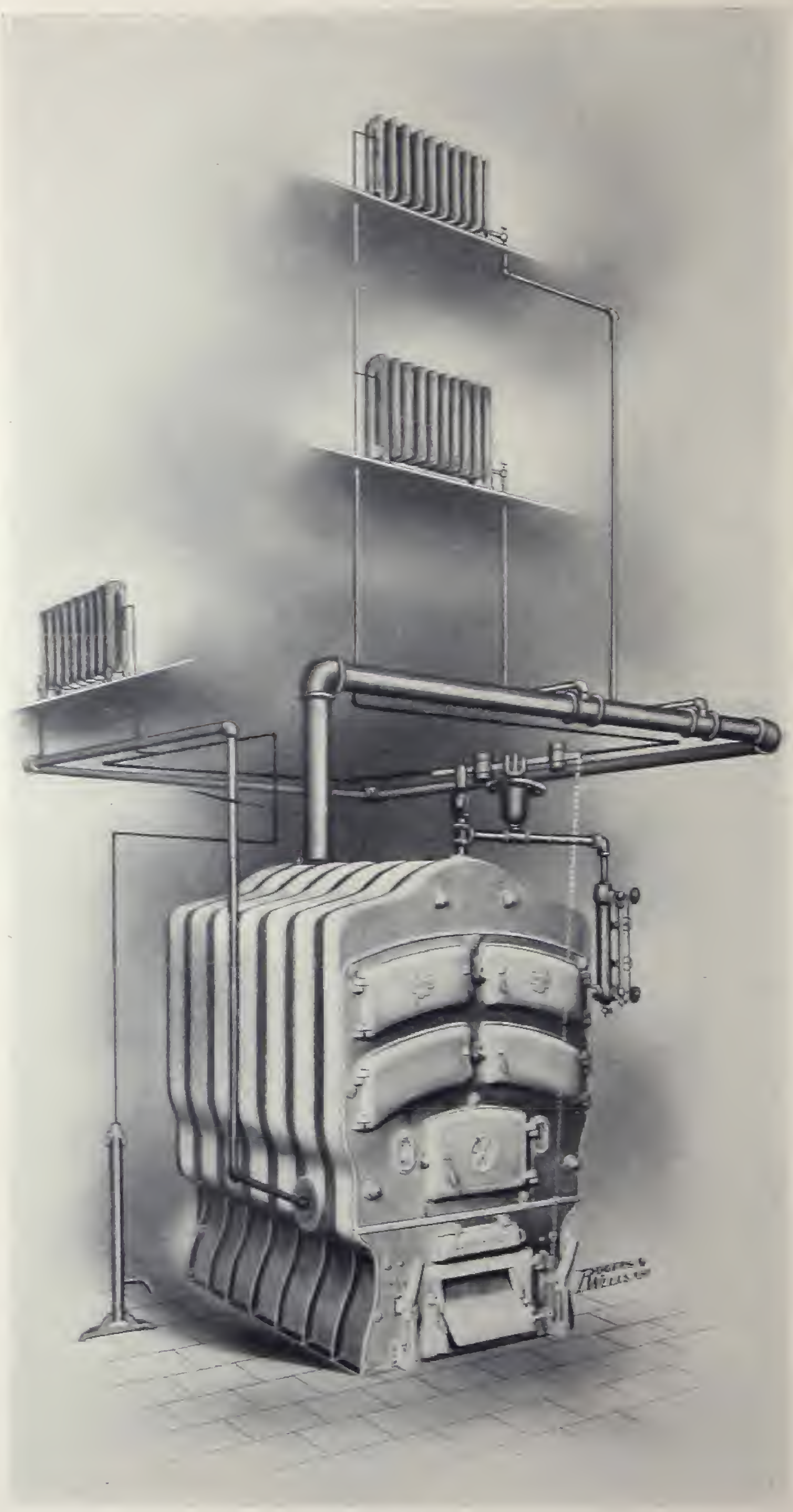


PLATE V

Plate V illustrates the Jas. A. Trane Indirect Gravity Vacuum System. With this arrangement the mercury seal, which is placed near the boiler in basement, is connected by a system of air piping, the Trane Automatic Air Valve being attached directly to each radiator. With this apparatus the weight of the diaphragm lever is adjusted to procure at least $\frac{1}{2}$ lb. pressure, or such pressure as may be required to warm a building in any weather. The pressure thus procured expels the air from the radiation, forcing same through the system of air piping, down through the mercury seal to the atmosphere.

When the temperature in the plant falls to 212°, and condensation takes place, vacuum is created; the pressure of air upon the surface of the mercury forcing the mercury up the mercury tube to a height corresponding to the difference between the internal and the external pressure.

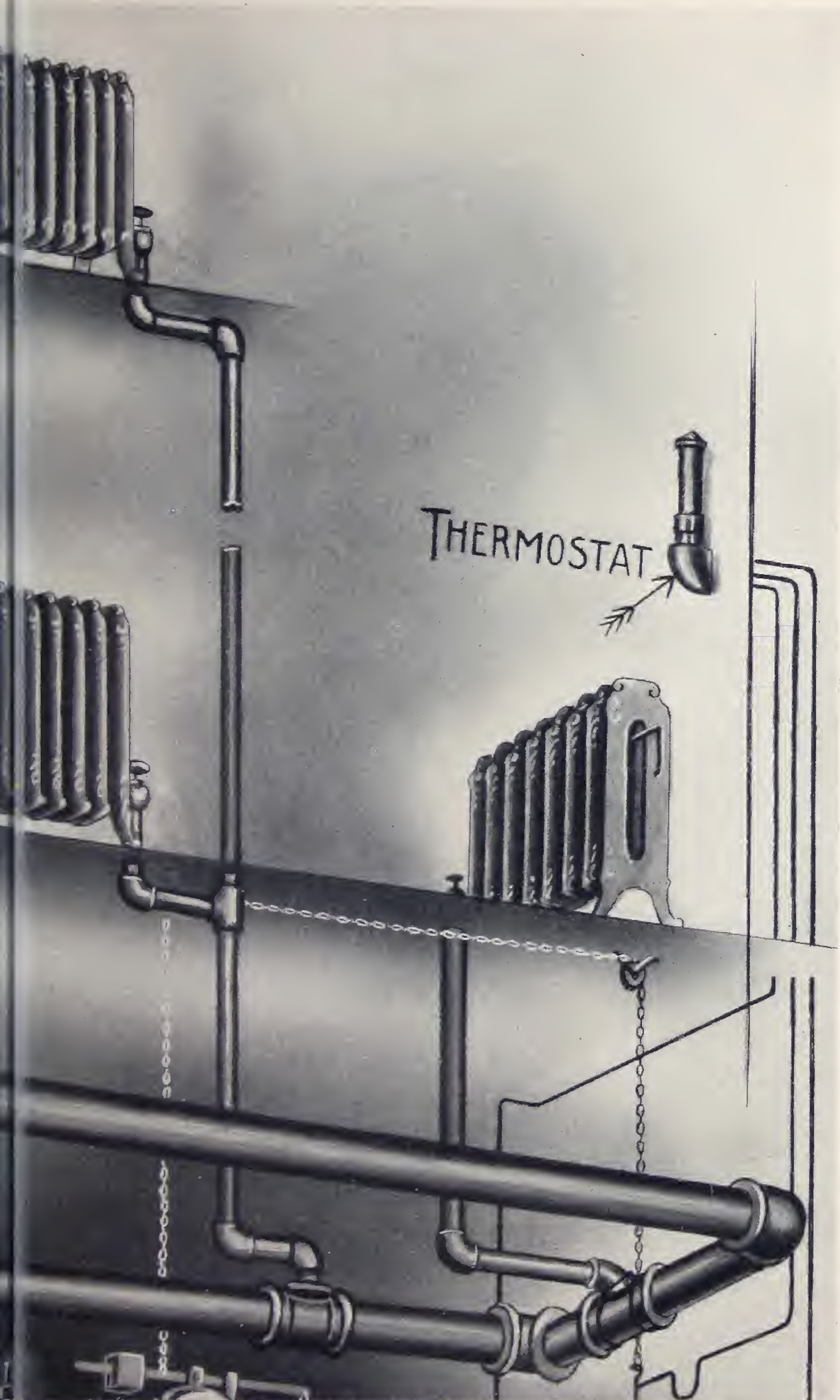
Sufficient mercury is provided in the seal to thoroughly overcome atmospheric pressure, which, at the sea level, is 14.7 lbs. In this way the air is prevented from re-entering the system, and thus, by condensation, vacuum is obtained and maintained for many hours, or if the plant is perfectly tight, forever, or at least an indefinite length of time.

Piping

With the Jas. A. Trane indirect method of Vacuum Heating, whereby a system of Air Piping is used, connecting all radiators with one mercury seal, located near boiler, the system is constructed as follows: Attach to each radiator a Trane Automatic Air Valve; this air valve is supplied with union to which connect a $\frac{1}{8}$-inch galvanized iron pipe; this pipe should then be run in the most convenient or out of the way place, preferably inside the partition, to the basement, where the several air pipes from the radiators are connected to the main, passing around the basement parallel with the steam main. The horizontal branches connecting the air risers to air main should be at least one size larger than the risers, and the main should not be smaller than $\frac{1}{2}$ inch for 500 feet of radiation, $\frac{3}{4}$ inch for from 1,000 to 2,000 feet of radiation, 1 inch for 3,000 feet of radiation, and should be connected with mercury seal as follows:

No. 1,	capacity	500	square	feet	air	main,	$\frac{1}{2}$	inch.
No. 2,	"	1,000	"	"	"	"	$\frac{3}{4}$	"
No. 3,	"	2,000	"	"	"	"	$\frac{3}{4}$	"
No. 4,	"	3,000	"	"	"	"	1	"

Plate VI gives a general illustration of the Direct Mercury Seal Vacuun
thoroughly understand the construction and arrangement of the Jas. A. Trane D



stem. This plate is intended to be of sufficient size to enable the reader to
t Mercury Seal Vacuum Heating System.

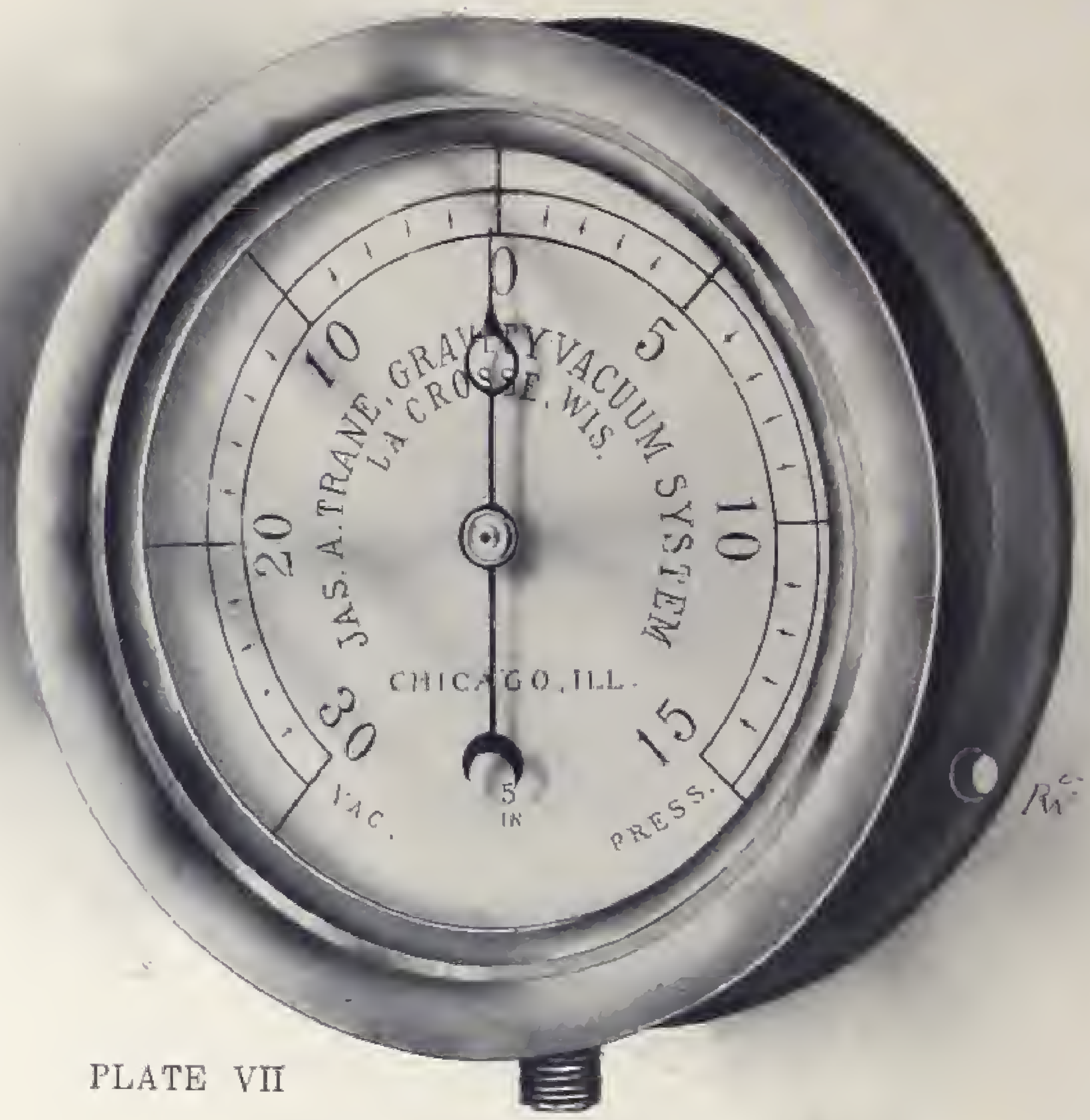


PLATE VII

Plate VII represents the Trane Compound Pressure and Vacuum Gauge. This gauge is especially manufactured for the Jas. A. Trane Vacuum Heating Co., and is thoroughly correct and reliable, only the best of material and workmanship being employed, our aim being to procure for the users of our apparatus the best appliances obtainable.

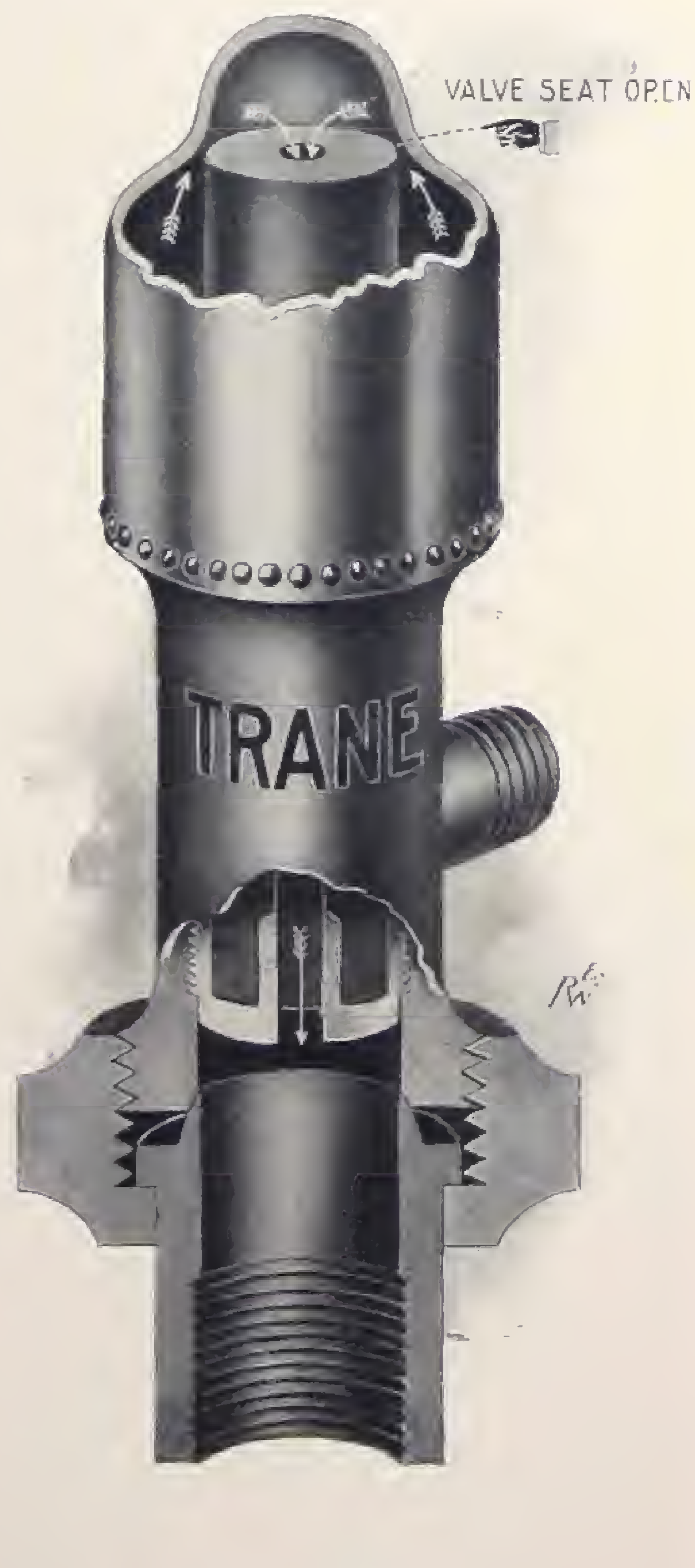
PLATE VIII

Plate VIII represents the Trane Pop Safety Valve. Those acquainted with low pressure steam heating realize the imperfections of the pop safety valve. Experience has demonstrated to us that the pop safety valves usually furnished with boilers are not reliable—and in many instances where we have been unable to maintain a high vacuum for any great length of time, we have found the trouble to be with the safety valve. We have therefore decided to place upon the market one that can be absolutely relied upon, and herewith illustrate the valve now supplied by us.

PLATE IX

Plate IX — It is difficult to find at the present time a thoroughly reliable automatic air valve. The inefficiency of air valves is due to many causes.

The aim of many manufacturers to cheapen their product places air valves on the market with imperfect joints and many sand holes. Further, the mechanism is based upon the cost of production rather than the desire to secure good results.



In the manufacture of the Trane Automatic Air Valve only the best of materials and workmanship are used, and each valve is thoroughly tested before being shipped. By manufacturing our own air valve we feel confident we will save those using the Trane Vacuum System much annoyance and expense.

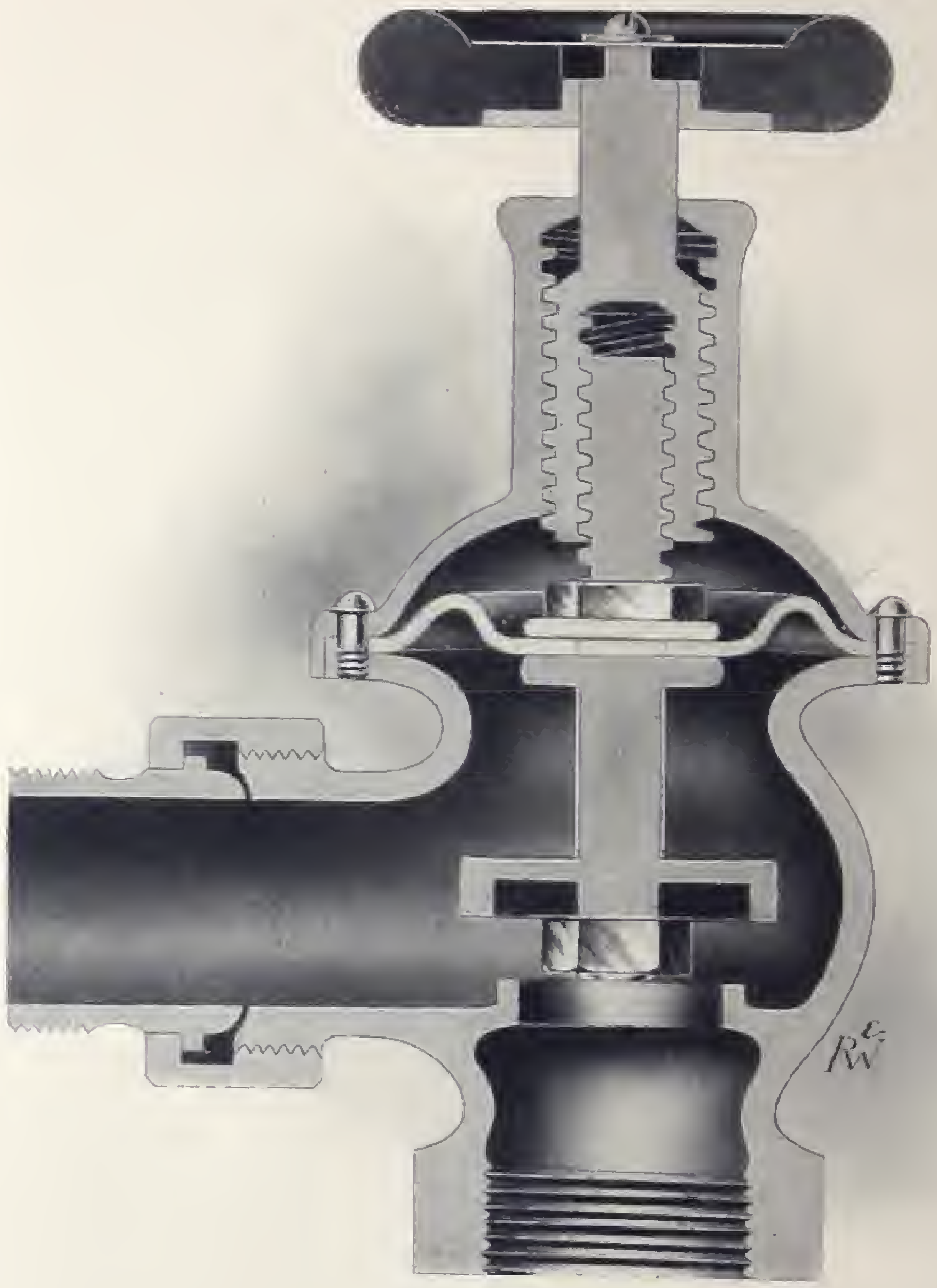


PLATE X

Plates X and XI represent the Trane Packless Radiator Valve. This valve is manufactured by us and designed expressly for the purpose of avoiding the usual stuffing box, thus doing away with one of the great annoyances with which vacuum heating engineers have had to contend. These valves are made from the best quality of brass, and are heavy and free from sand holes. The workmanship is of the very best, and the valve finished according to the list shown.

This valve is furnished with union, and Jenkins' disc. The right and left threaded spindle produces double action, and requires only one-half the turning of the ordinary radiator valve.

The diaphragm is made of material particularly adapted to this special use, and to withstand steam pressure.

PLATE XI

Plate XII represents our Direct Mercury Seal as attached to a two-column radiator, the pipe thereof extending upward, thus retaining condensation until such time as the air valve allows the same to re-enter the radiator.

This plate illustrates the construction of the Direct Mercury Seal as furnished for the two-column radiator.

PLATE XII

Plate XIII represents the same seal, but shows the manner of attachment to a three-column radiator.

Where low radiators are used, and the height does not exceed 22 inches, the pipe is allowed to pass through the floor, allowing for at least 30 inches of mercury. It is not necessary that the seal be placed below the radiator, but may be placed in a convenient location, either above or below the radiator.

PLATE XIII

Plate XIV illustrates the Jas. A. Trane Direct Mercury Seal Vacuum Heating Apparatus arranged to be controlled by both diaphragm and thermostat. In our opinion this method is more practical and economical, and will become more universally used.

In this illustration, the mercury seal, in connection with a Trane Automatic Air Valve, is attached directly to each radiator. The steam is supplied through a Trane Packless Radiator Valve as illustrated in plate XI. This illustration further shows the use of a specially designed Diaphragm or Regulator, this regulator being constructed to combine the usual diaphragm and water-bottle, thus avoiding many joints. It is provided with a sufficient quantity of water to procure positive action at all times, and prevent the ruinous effect of steam upon the rubber diaphragm. The water column (specially designed) is so constructed as to avoid all unnecessary joints, the syphon for steam gauge being cast in the top of water-column, and the openings for try-cocks omitted. It will further be found more practical to omit the steam gauge cock, thus avoiding two joints and a valve. We would advise the use of a boiler employing push nipple connections, also, one where the rods used for connecting sections do not pass through the water-way. In connection with this apparatus, we show a National Thermostat, which, with this diaphragm, produces a complete vacuum heating apparatus.

After erecting a plant similar to the one shown in this illustration, the fitter should, with the use of an airpump, thoroughly test the apparatus, placing same under a pressure of not less than twenty-five pounds, which pressure should be retained within ten pounds for a period of not less than twelve hours. After securing a satisfactory air-test, the apparatus is ready for use. Fill the boiler with clean water to a height covering the fire surface. The fire should then be started, and a pressure of not less than ten pounds of steam raised, at which time the fire should be drawn and the blow-off opened, thus thoroughly cleaning the system of all foreign substance. After the boiler has thoroughly cooled and been refilled the fire may be rebuilt.

The weight on the diaphragm should be adjusted to the requirements of the weather, allowing for at least one-half pound steam pressure. The air of the room wherein the thermostat is placed, being below the required temperature,

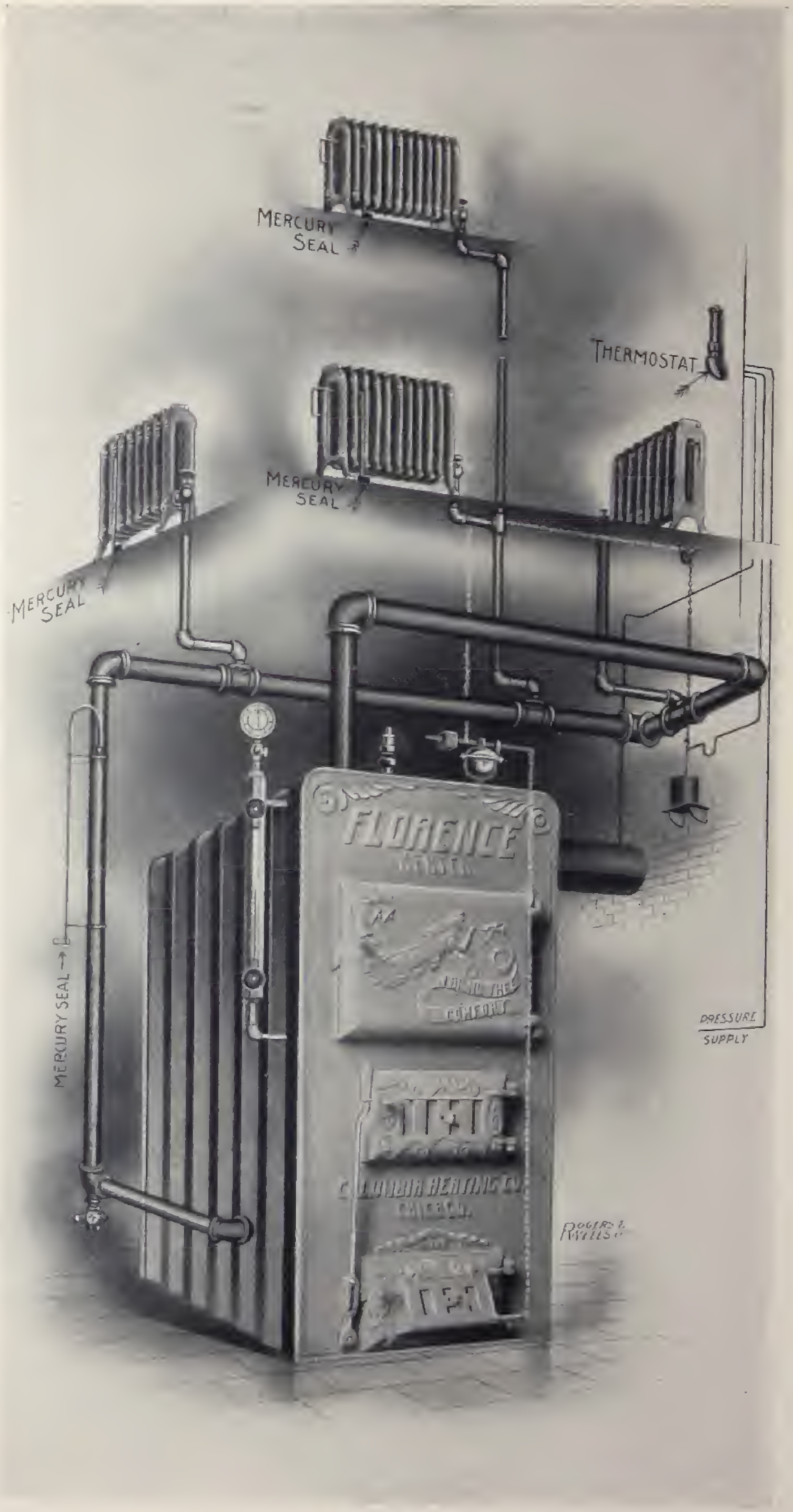

MERCURY SEAL
THERMOSTAT
MERCURY SEAL
MERCURY SEAL
MERCURY SEAL
PRESSURE
SUPPLY

PLATE XIV

permits the diaphragm regulator to operate the draft doors, according to such pressure as the diaphragm weight will allow. Should the weather be cold, it will be found that the diaphragm will maintain a steam pressure for some time before the temperature of the air in the room reaches the point at which the thermostat is set. Immediately upon the air reaching the desired temperature, the thermostat, which is connected to the diaphragm lever, assumes control of the fire, and continues in control until such time as the temperature of the steam under vacuum is unable to supply sufficient heat to maintain the required temperature in the room, when the thermostat transfers the control of fire again to the diaphragm. At this time, in an ordinarily tight apparatus, the system should be under a vacuum of not less than twenty or twenty-eight mercury inches, procuring boiling temperatures ranging from 161° down to 108°. Should the vacuum in this instance, be equal to twenty-eight inches, it will be found when the diaphragm opens the drafts of heater, ebullition takes place at 108.4°, instead of the temperature of 212° necessary to boil water under atmospheric pressure, as with a low pressure steam apparatus.

As the same quantity of water is required in a boiler used with a low pressure steam apparatus or a vacuum heating system, one will readily realize the vast economy in fuel; it taking but a small amount of fuel to boil water at 108.4°, as compared with the required temperature of 212° for a low pressure steam apparatus.

Economy alone is not the only thing to be considered in connection with Vacuum Heating. Until recently, hot water heating has been generally conceded to be the most healthful of all artificial heat, but, since the invention of the Mercury Seal, one is enabled to secure from a steam apparatus, temperatures equal to those of hot water, thus securing at a much less first cost, and with economy in fuel, the same results. Steam is no warmer at 120° than water at the same temperature, and should with justice be given equal place.

The ability of the Trane Vacuum System to thoroughly expel the air and retain vacuum, secures for the user a radiator nearly double in efficiency to one of a low pressure steam system. Considering this advantage, one will recognize the ability of the vacuum system to produce desired results with the same sized radiator as used with low pressure steam. To the architect this will not be the least pleasing feature in vacuum heating, and the lady of the house will now find a place for that choice

bit of furniture. Besides reserving in the room much space required by a hot water radiator, one is enabled to secure the same results at a much less cost. Many tests in the past have demonstrated to the satisfaction of the leading Heating Engineers the ability to heat with a vacuum apparatus with a saving in fuel of from twenty-five to fifty per cent, as compared with the fuel required for a hot water heating apparatus. Tests have been made between low pressure steam and vacuum apparatus, which have demonstrated the ability of the vacuum plant to secure superior results with a saving in fuel of seventy-five per cent. The latter tests, however, were made for a time of but a few hours, and in our opinion, are much higher than the user would be able to obtain in general.

The use of the Jas. A. Trane Mercury Seal in connection with a low pressure steam apparatus, converting the latter into a vacuum heating system, does not prevent the carrying of low pressure if desired. In fact, the thermostat will repeatedly cause to be carried both vacuum and pressure. It should then be understood, that with the Trane Mercury Seal, one possesses the ordinary low pressure apparatus, and, in connection with same, all the benefits derived from a Vacuum Heating System.

If care is taken in the selection of a boiler to be used in connection with a vacuum system to secure one possessing as much direct heating surface subjected to the direct ray of heat of fire, enabling boiler to supply sufficient steam with checked fires, it becomes unnecessary to give the heater attention more than twice a day, the user thereby saving labor and annoyance, besides securing better results with much less fuel.

Under vacuum, water boils at 98°, or any temperature above. It will be seen that after the temperature in the apparatus is reduced below 212°, the vacuum heating system, unlike a low pressure steam system, continues to supply the necessary steam to warm the room. The greater the condensation the more rapid the generation of steam, as by condensation the system is relieved of pressure, permitting ebullition to take place and refill the space made vacant by condensation. This action is continued by the thermostat, which automatically opens and closes the drafts of heater until such time as the fuel in the boiler has ceased to be of sufficient value to generate the necessary steam to maintain the desired temperature in room. It then becomes necessary to replenish the fire. This, however, is much less frequent than with a low pressure steam apparatus requiring higher temperatures.

Referring to the following table, which we present, we believe, for the first time, one will note the different temperatures at which water boils under different degrees of vacuum as expressed in even inches.

Boiling Points of Water at Different Heights of Vacuum

Height of Mercury in inches.	Temperature Fahrenheit.	Height of Mercury in inches.	Temperature Fahrenheit.
0	212	16	175.8
1	210.3	17	172.6
2	208.5	18	169.0
3	206.8	19	165.3
4	204.8	20	161.2
5	202.9	21	156.7
6	200.9	22	151.9
7	199.0	23	146.5
8	196.7	24	140.3
9	194.5	25	133.3
10	192.2	26	124.9
11	189.7	27	114.4
12	187.3	28	108.4
13	184.6	29	102.0
14	181.3	29.92	98.0
15	178.9		

We are often asked if we are able to maintain vacuum for any great length of time. If you have a poorly constructed apparatus it will retain a vacuum of from ten to twenty inches for at least five to ten hours. The majority of low pressure steam plants of today, if supplied with our mercury seal, will be capable of maintaining vacuum of from fifteen to twenty-eight inches for from ten to forty hours. Should a system be so poorly constructed that vacuum would last but a few minutes, the user will at least secure the results he would have secured if used only as a low pressure steam apparatus. The results, however, would be so thoroughly unsatisfactory that the apparatus would soon be reconstructed, as it would be unable to retain steam pressure. Any apparatus so constructed as to maintain steam pressure of from two to five pounds for an indefinite length of time should, in our opinion, secure for the user an economy in fuel of at least twenty-five per cent. as compared with low pressure steam or a hot water heating system. The majority of our vacuum systems now in use, prove themselves capable of maintaining a vacuum of from twenty to twenty-eight inches for days, enabling one to procure steam at temperatures ranging from 108° to 161°.

With the Trane Vacuum system, steam pressure expels the air and condensation creates a vacuum; thus it will be seen

that with a thermostat and diaphragm regulator, steam pressure is procured often and condensation takes place constantly.

Jas. A. Trane Indirect Mercury Seal

No. 1	capacity	500 sq. ft. radiation,	pipe connection	½ inch	$ 70.00
No. 2	"	1000 "	" "	¾ "	100.00
No. 3	"	2000 "	" "	¾ "	160.00
No. 4	"	3000 "	" "	1 "	220.00

Jas. A. Trane Direct Mercury Seal

Mercury Seal including Air Valves with Union $10.00

Jas. A. Trane Pop Safety Valve

¾ inch polished brass	each,	$ 3.00
1 " " "	"	4.00
1¼ " " "	"	6.00
1½ " " "	"	10.00
2 " " "	"	12.00

Jas. A. Trane Packless, Quick-Opening Radiator Valve

With right and left threaded Spindle, with Union and Jenkins Disc.

Finish	Size				
	¾ inch	1 inch	1¼ inch	1½ inch	2 inch
Rough Body, Finished Trimmings	$3.50	$4.30	$5.85	$7.75	$12.60
Rough Body, Plated all over . .	3.80	4.75	6 40	8.10	13.10

Jas. A. Trane Automatic Air Valve

Jas. A. Trane Self Adjusting Nickel Plated Automatic Air Valve with Union, ⅛ inch $1.25

Jas. A. Trane Compound Gauge

Compound Gauge $7.00